VIEWPOINT MODELING AND MODEL BASED MEDIA GENERATION FOR SYSTEMS ENGINEERS

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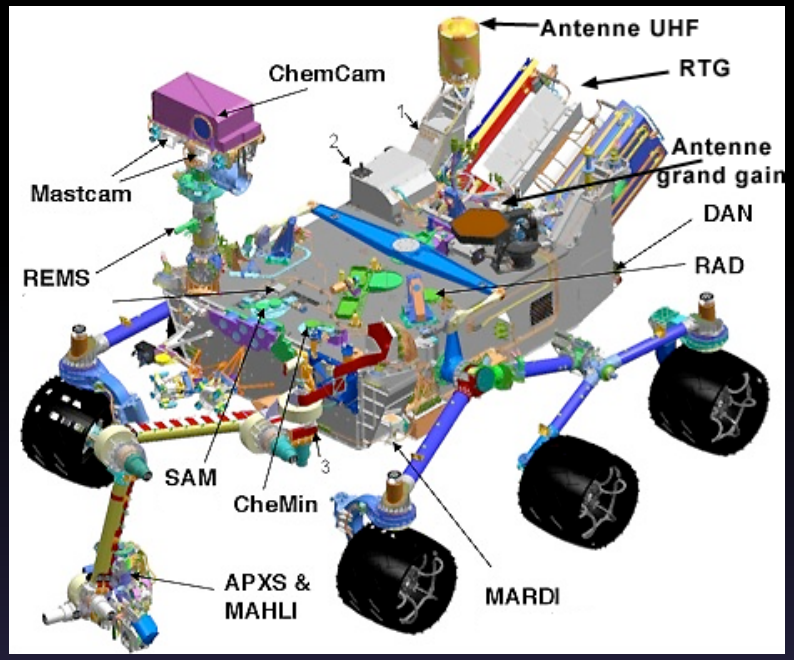
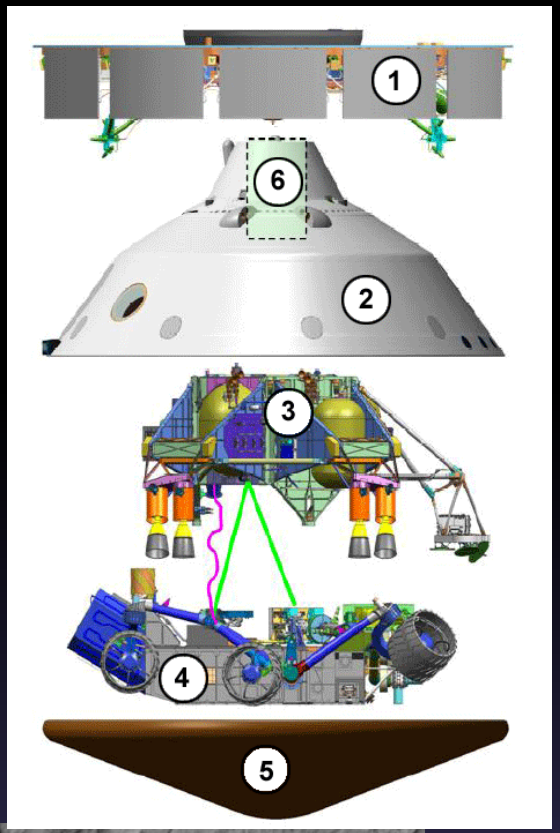
Outline

- Docgen at JPL and Across Industry
- Communication
  - Models and Views
  - Methods and Analysis
  - View Models and Linearization of the Story
  - Libraries and Reusability
- Viewpoint as an Architecture for a Scalable Model Based Engineering Environment

JPL Systems


Antenne UHF
ChemCam
RTG
Antenne grand gain
Mastcam
DAN
REMS
RAD
SAM
CheMin
APXS & MAHLI
MARDI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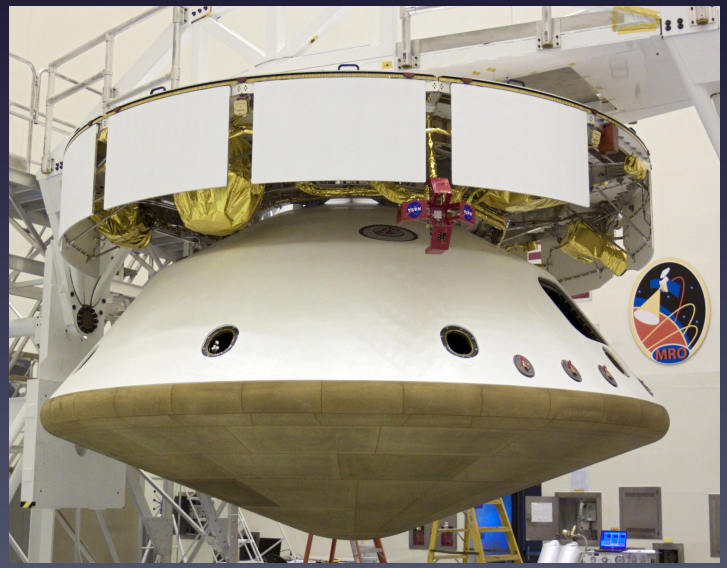
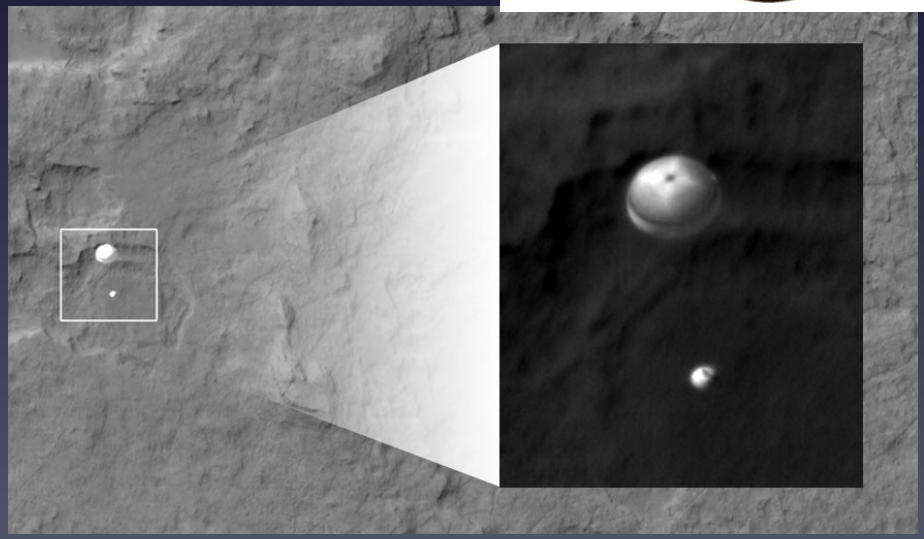
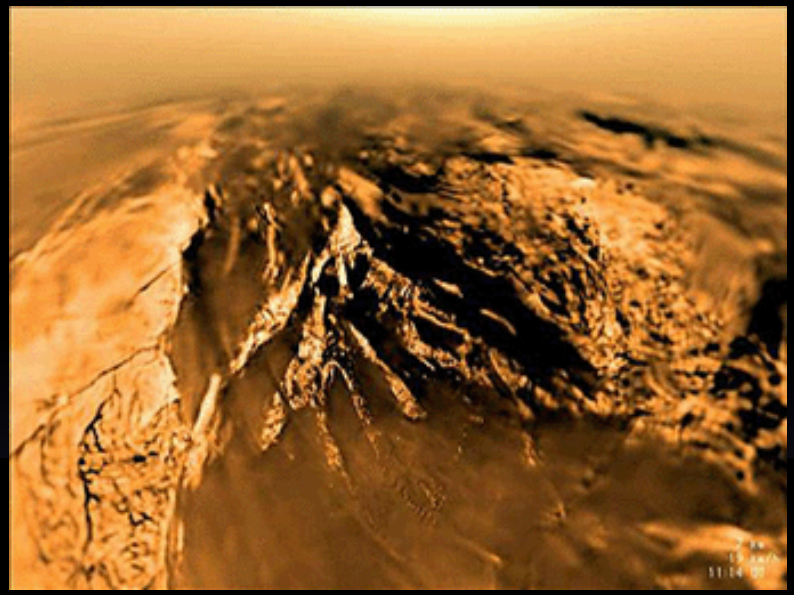
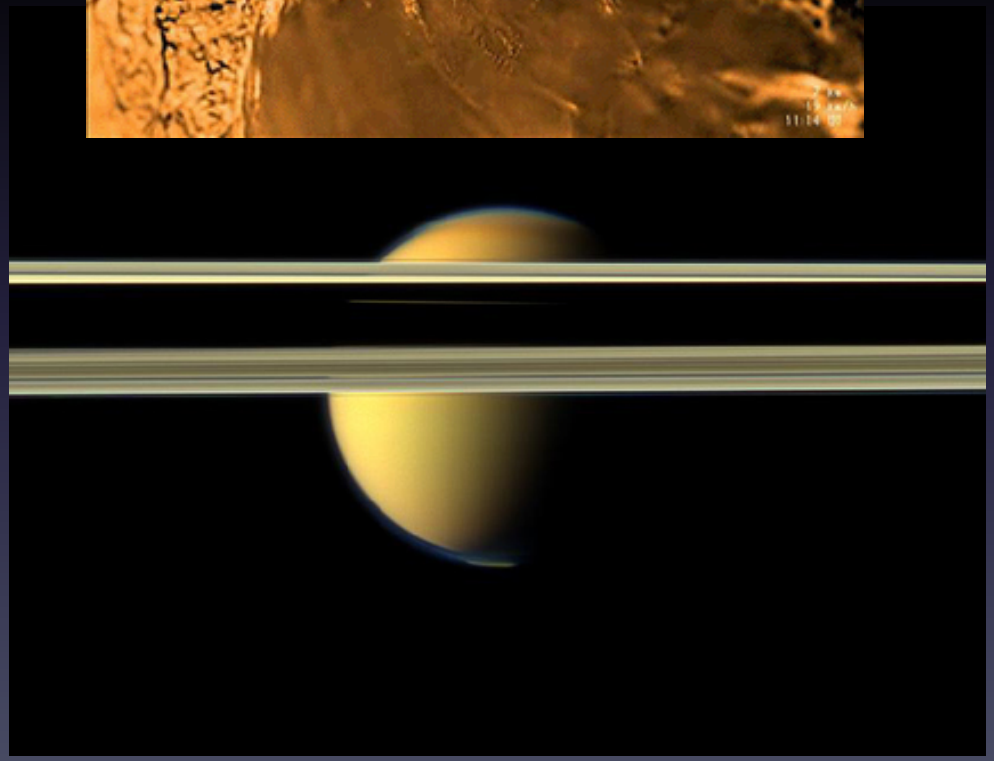

MRO







Modeling and Document Generation at JPL

- Developed on the Multimission Ground Systems and Services Ops Revitalization Task
  - Based on previous MBSE pilots at JPL
  - 200 users
  - ~20 projects and tasks
  - Removes barrier to using models in real engineering products

Efforts Across Industry

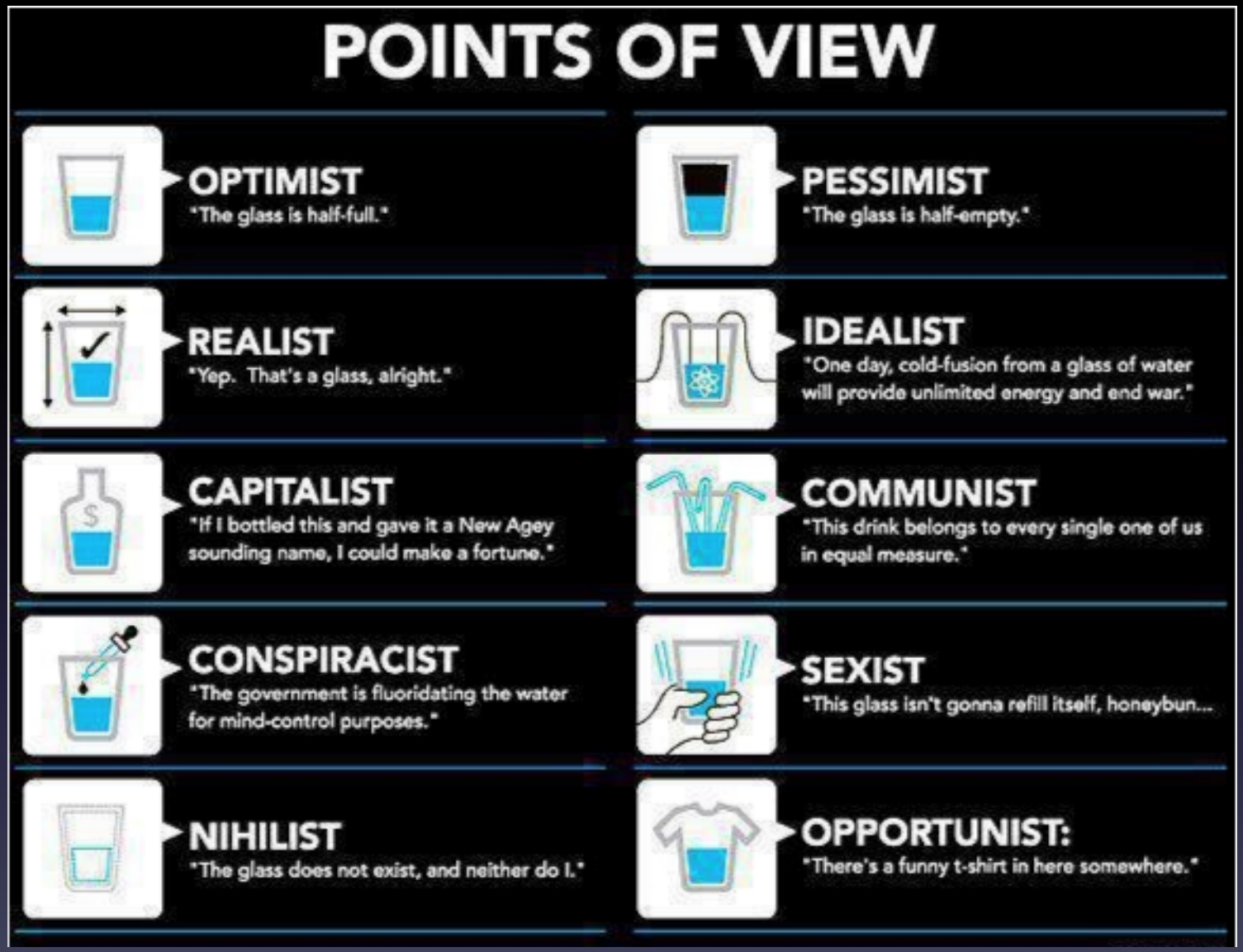
- ESO Open Source Docgen
- JPL MBEE (Docgen, Docweb, View Editor, System Database)
- Lockheed Martin Document Generator
- Atos Gendoc

Common Features Across Industry

- A need to communicate with stakeholders
  - According to terms of the stakeholders
- Variety of representations
- Edit the Model Information through multiple UI
  - Views at the stakeholder level
- Enterprise integration of multiple applications and modeling tools
  - Views that facilitate integration between applications

Communication as a Principle

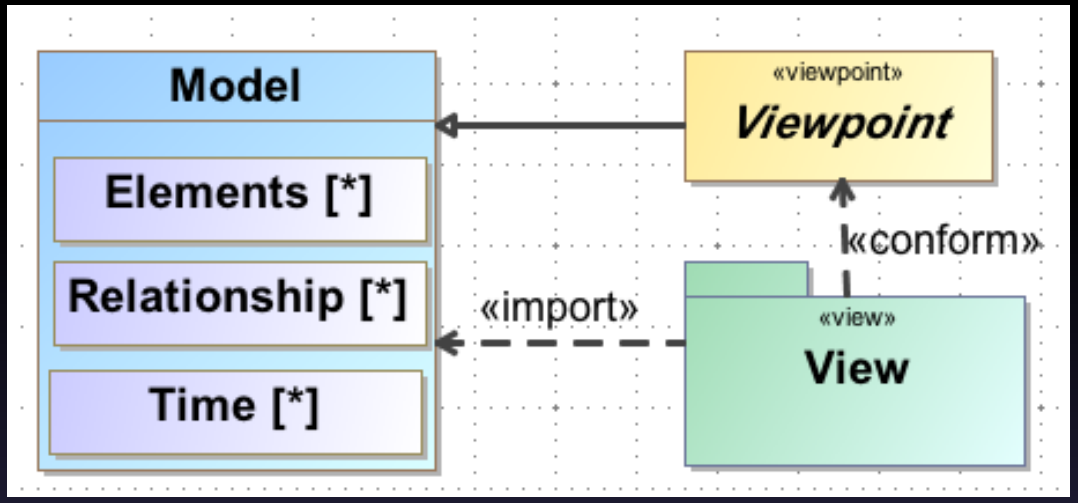
- Communicating through understanding point of view
  - Understanding the Point of View of Stakeholders
    - Concerns
  - Describing the model from that Point of View
    - Identifying parts of the model that address concerns
  - Telling the story of the Views
    - Linearization of the Views of the Model



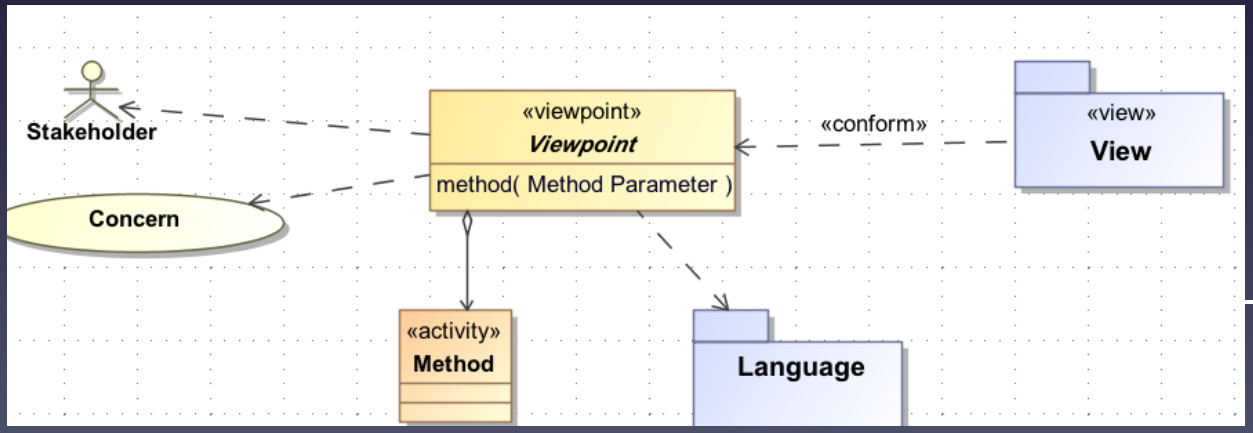
Engineer

"The glass is twice as big as it needs to be"

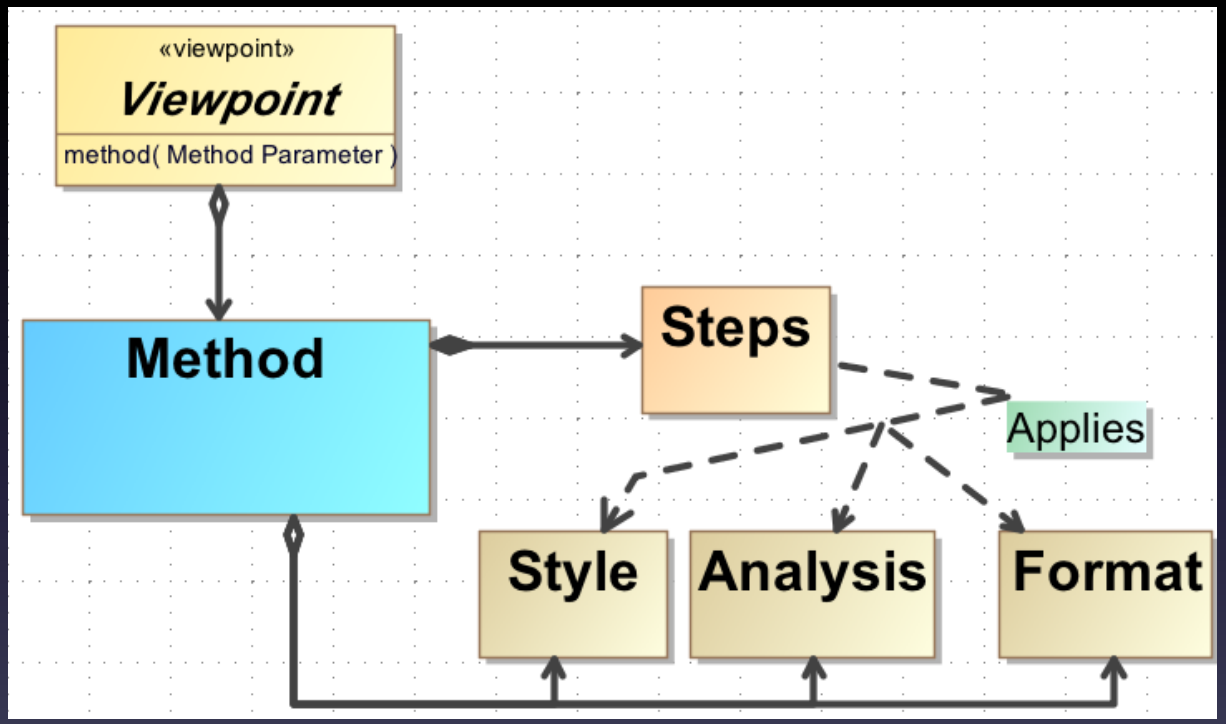
Building the Viewpoint Model



- Viewpoint Model
  - Purpose informed by Stakeholder Concerns
  - Methods and Analysis for constructing the View from the Model
  - Presentation Rules

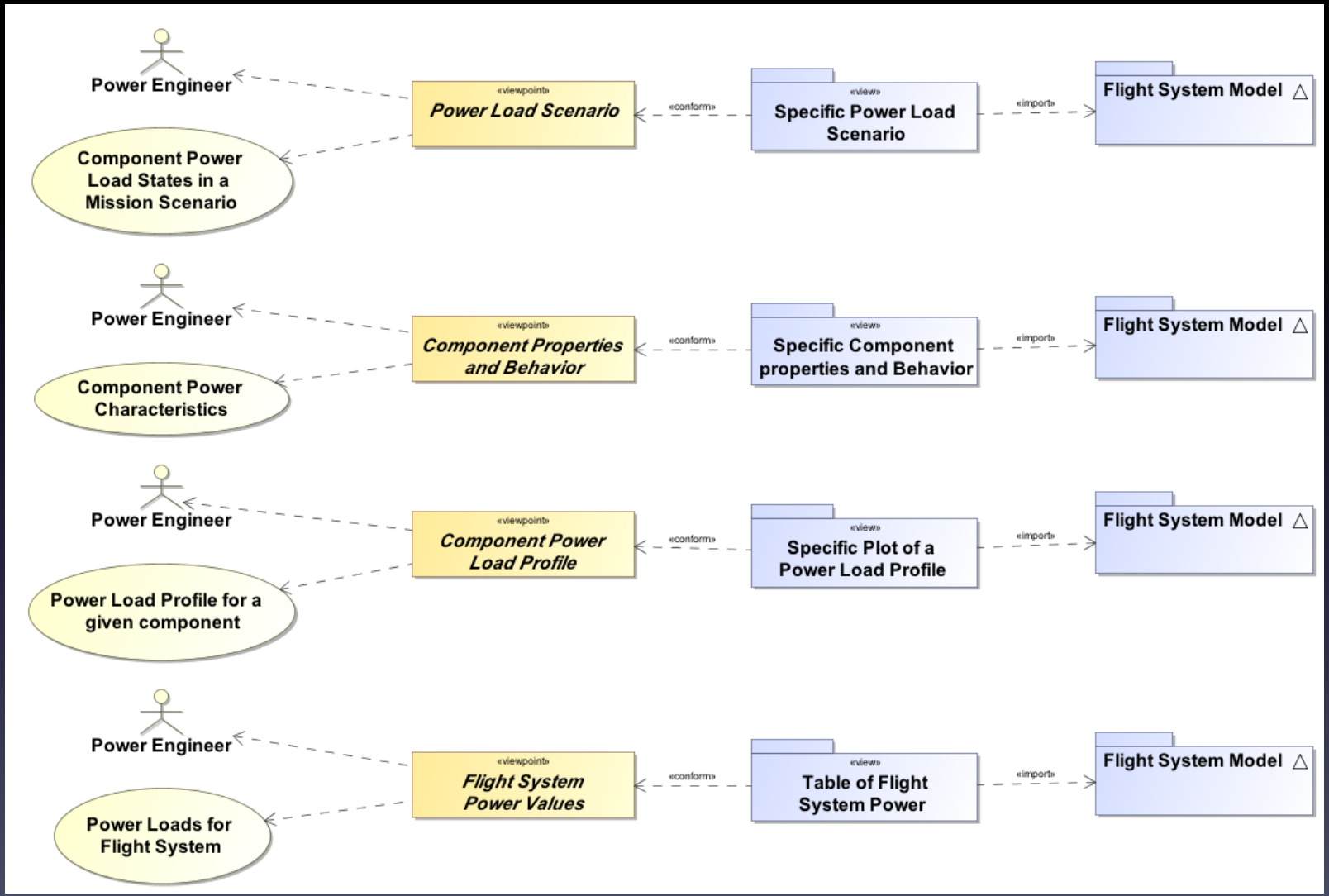


Method and Analysis



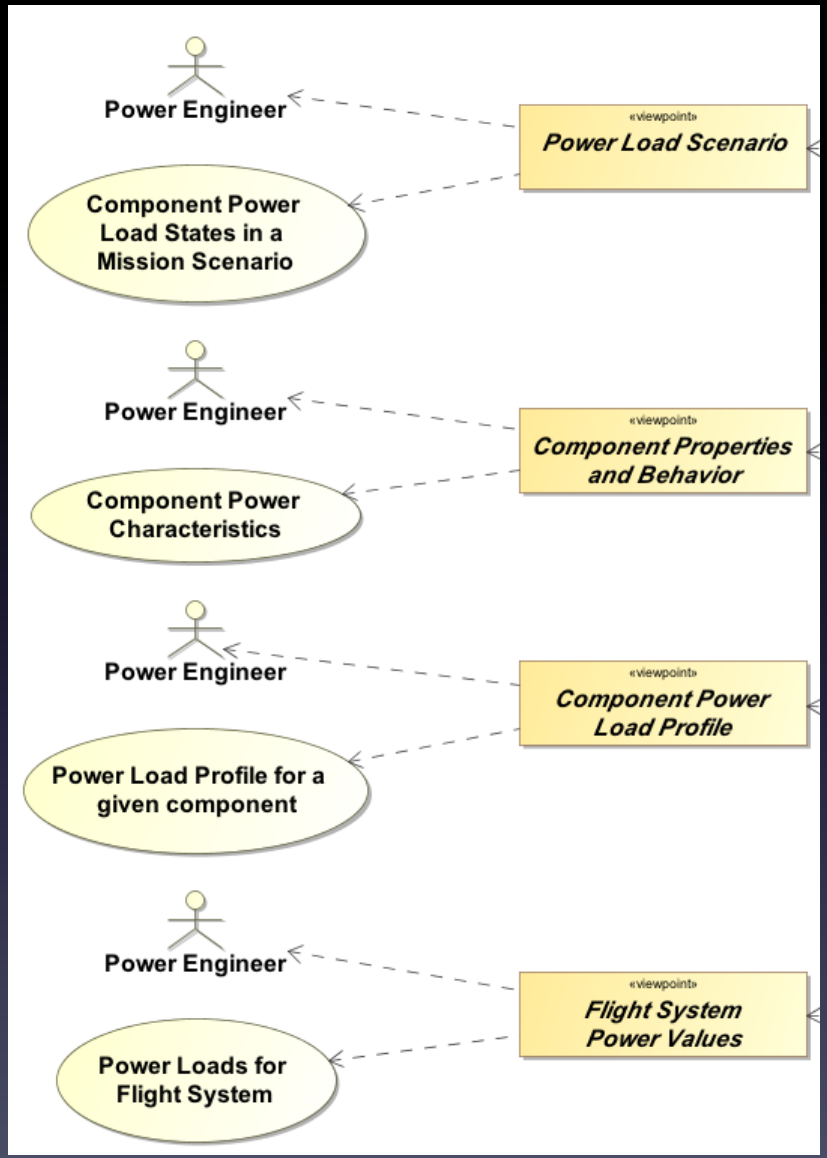
- Methods
  - Ordered steps for producing the View
- Analysis
  - describe the nature of queries of the model
  - Analytical assertions
  - Rules for completeness and consistency
- Format and Presentation Style
  - Describe the conventions styles and formats for how the information is presented in the View

Viewpoint and View

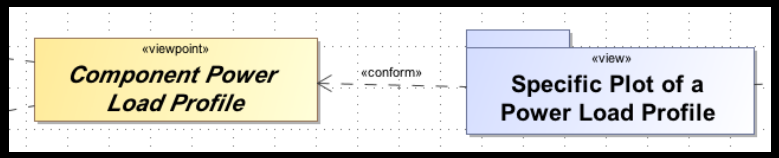


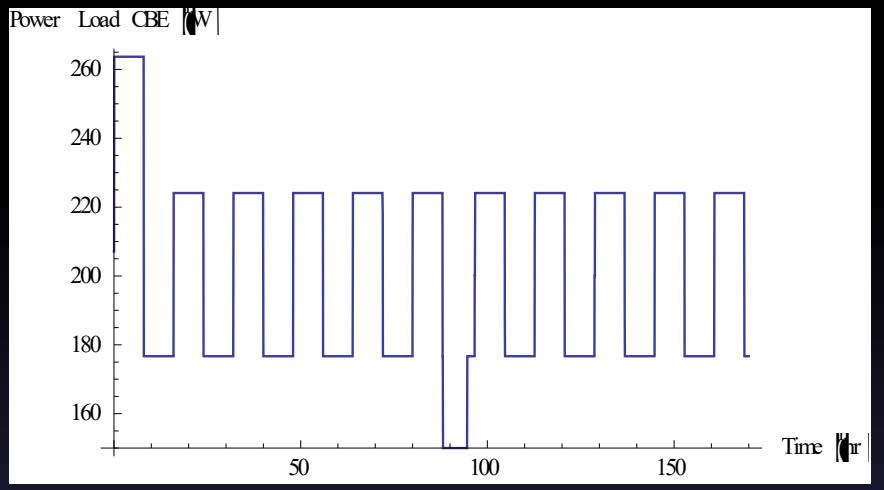
Viewpoints

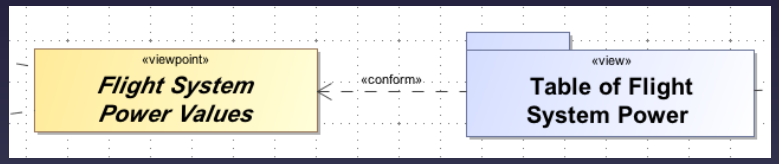
- Power from the point of view of:
  - Scenarios of component states
  - Components and properties and behavior
  - Power Load Profiles
  - Flight System Power



Views of Models

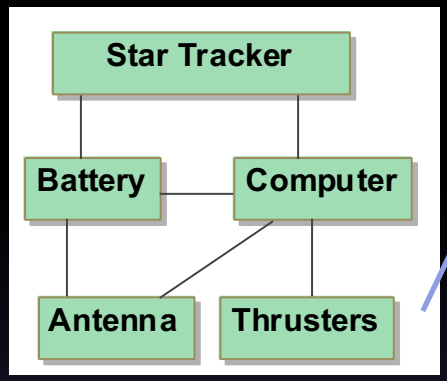




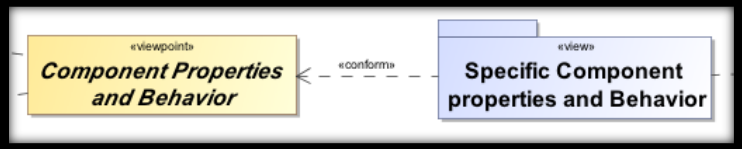


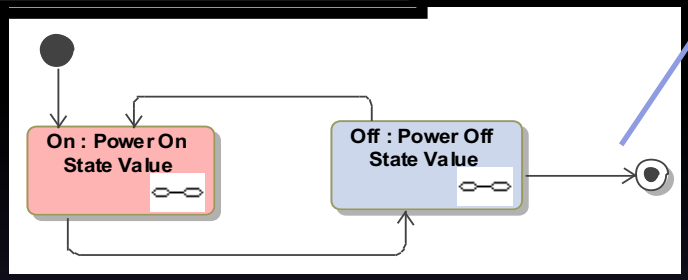
	Workpackage	Product	Number of Units	Cruise				
				State	Duration [%]	Steady-State Power CBE [W]	Contingency	Steady-State Power MEV [W]
1	00 Europa Habitability Mission Project					77	0.3	100.1
2	05 Payload System					0	0	0
3	06 Spacecraft System					77	0.3	100.1
4	06.06 Telecom SS					64	0.3	83.2
5		TWTA (TWTA)	1	Off, On		64	0.3	83.2
6				Off	20.0%	0	0.3	0
7				On	80.0%	80	0.3	104
8	06.07 Mechanical SS					8	0.3	10.4
9		SDST (SDST-A)	1	Standby		4	0.3	5.2
10		SDST (SDST-B)	1	Standby		4	0.3	5.2
11	06.10 GN & C SS					5	0.3	6.5
12		Reaction Wheel (RWA)	1	Low Speed		5	0.3	6.5

Simple Spacecraft Diagram Views

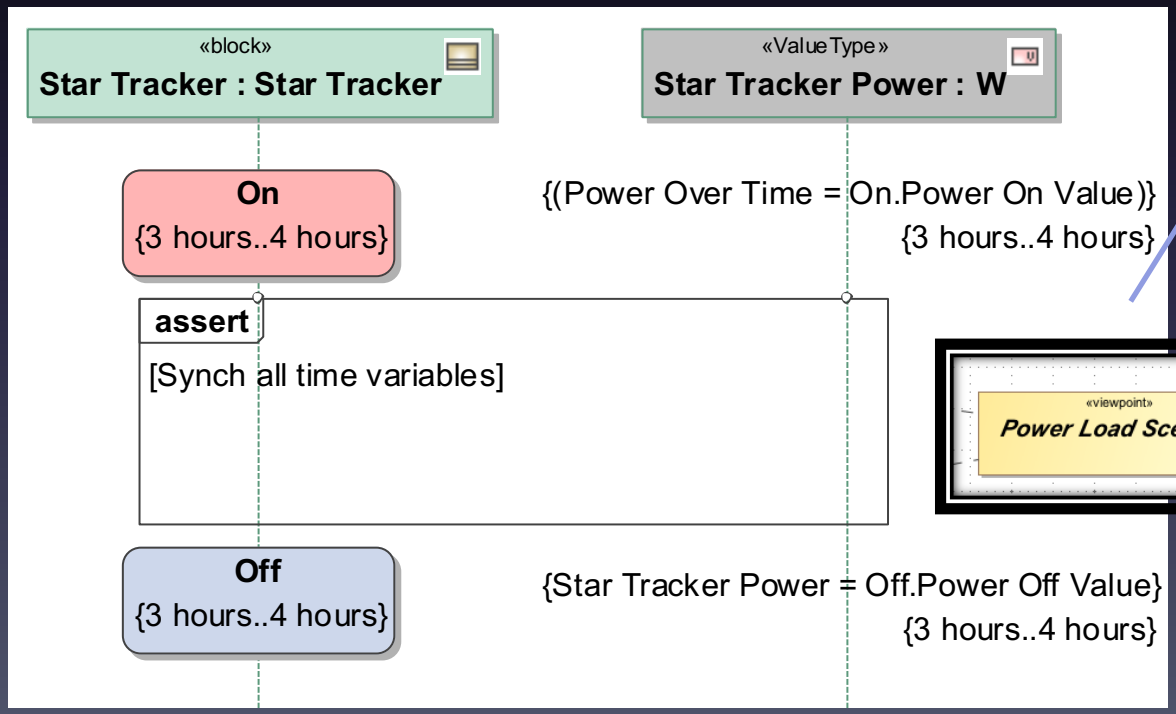


Spacecraft SysML IBD

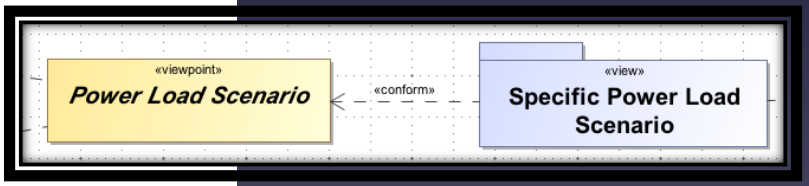




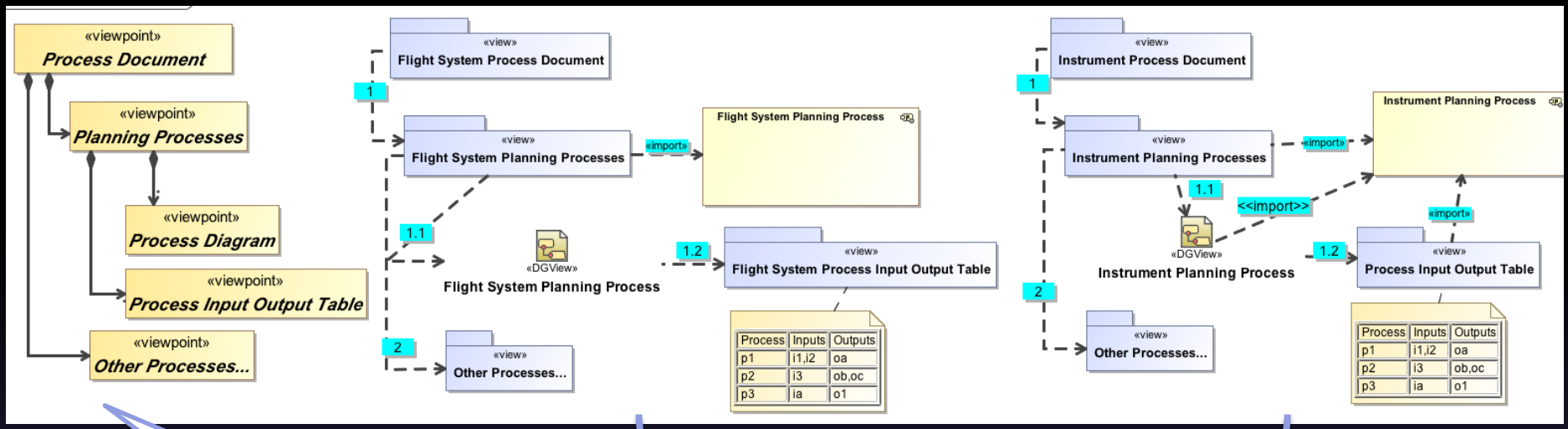
Spacecraft Star tracker Behavior



Star Tracker Behavior Scenario



Linearizing the Views



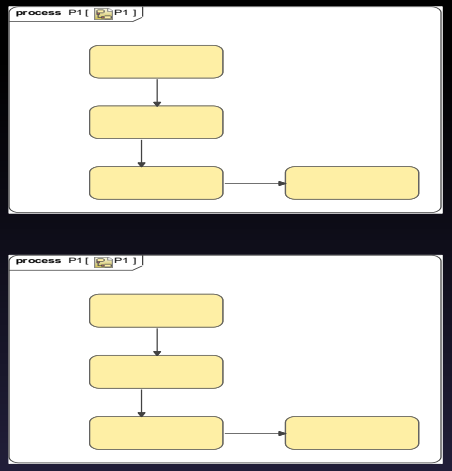
"Template" Outline of Viewpoints

2 Model Outlines of Views based on the same Viewpoint Template

- Model of Views
  - Story of Views
  - Outline of Views
  - Template Outline of Viewpoints

Operations Processes and Checklists

Training Document

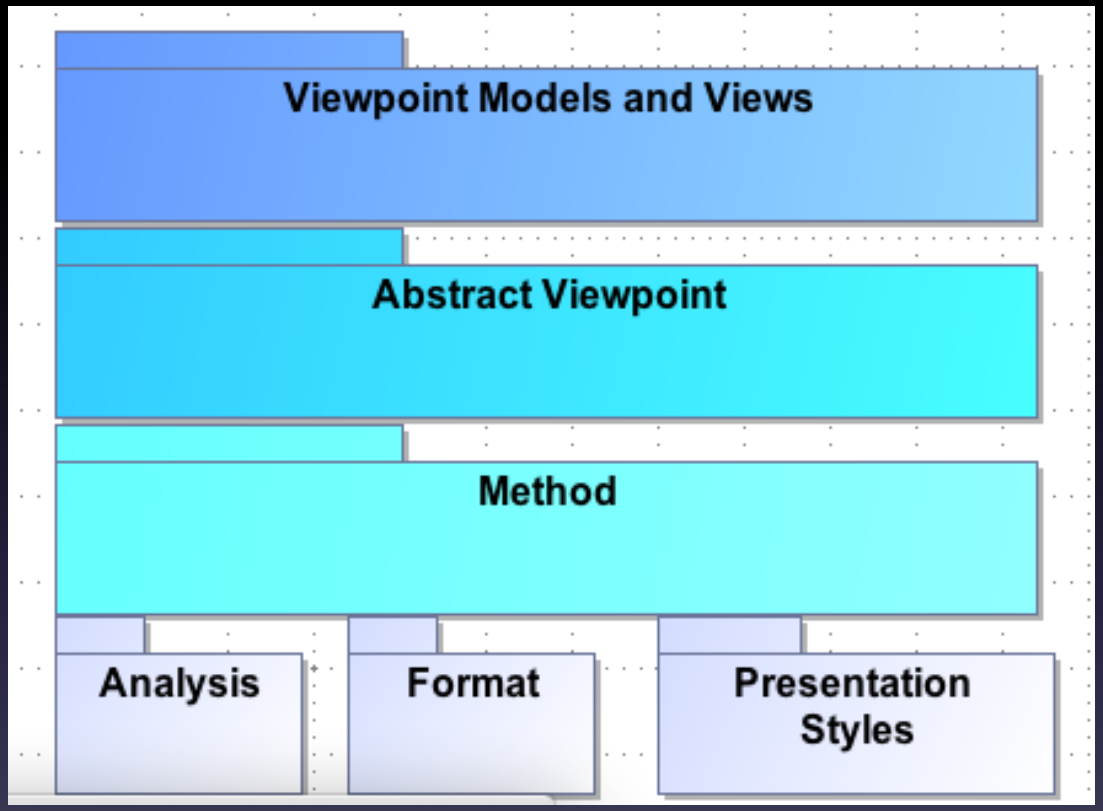


Operational Checklist

1. Step 1
2. Step 2
    1. Sub Step 1
    2. Sub Step 2

- Training View Models
  - Layered Story through process
  - Understand bigger picture down to smallest detail
- Checklist Views
  - Single thread through entire process
  - Layout the clean step-by-step
  - Minimum amount of information to do the job

Libraries

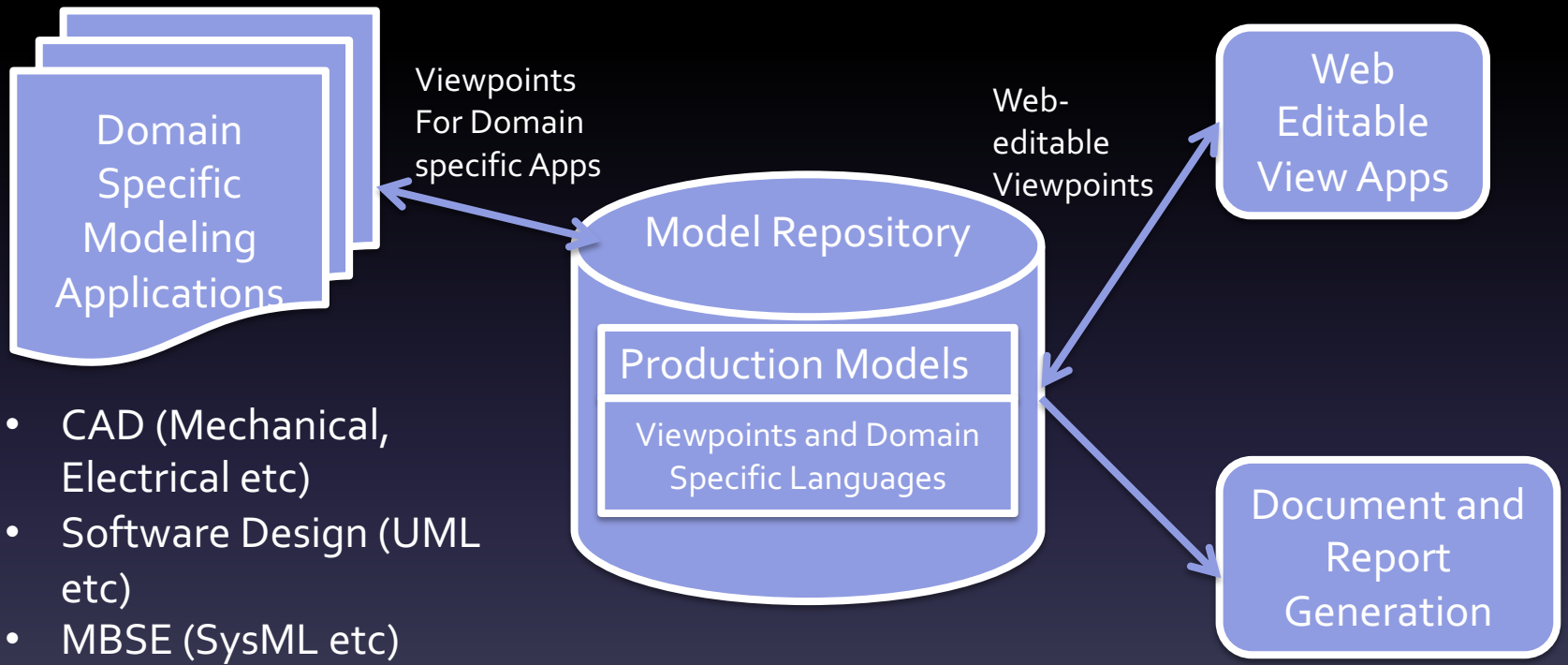


- Viewpoints
  - Collections of standard representations
- Methods
  - Reusable methods for producing different models and representations used in Views
- Analyses
  - Libraries of model analyses, queries and rules for checking models
- Presentation Styles
  - Styles for presenting models and data such as colors, layout schemes, and conventions
- Format
  - Models for formatting information such as Docbook, Office Schemas and modeling languages

Software Environment for MBSE

- Model Based Engineering Environment
  - An environment for developing mutually correspondent and consistent engineering models
- Engineering Modeling Information Systems
  - A class of Information Systems design to enable the development of engineering models

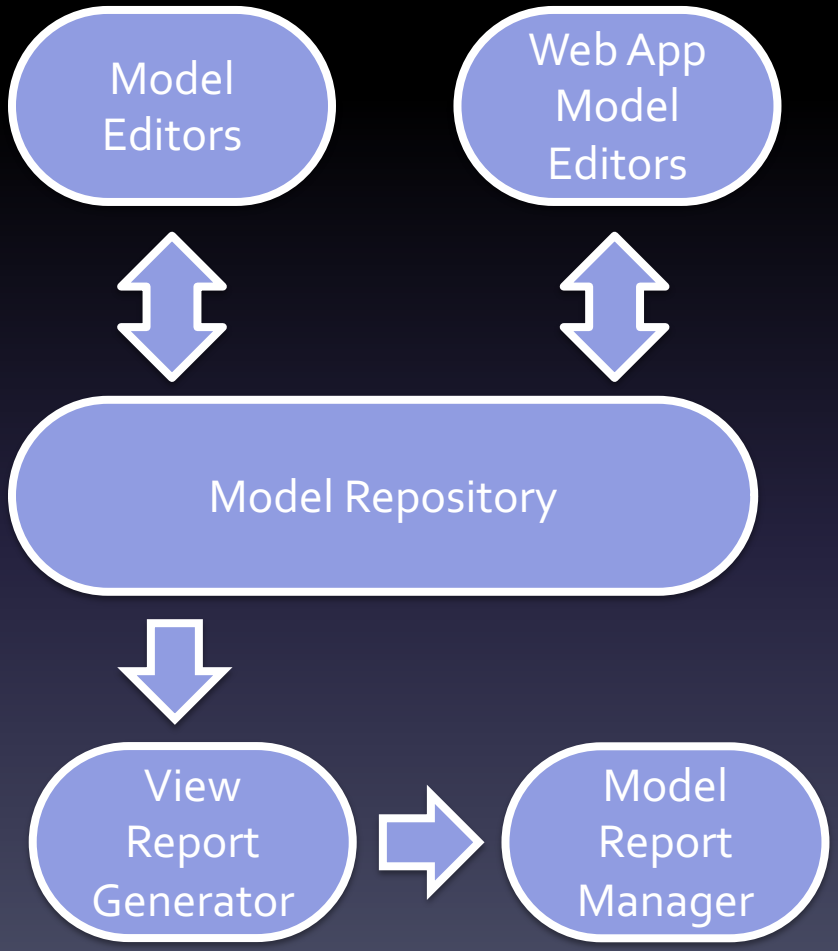
Information Rendered According to Viewpoints

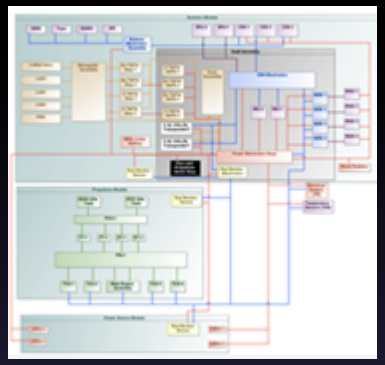


- CAD (Mechanical, Electrical etc)
- Software Design (UML etc)
- MBSE (SysML etc)
- Analysis (Analytic, Simulation, spreadsheet)

- Final products rendered according to Viewpoints and Models

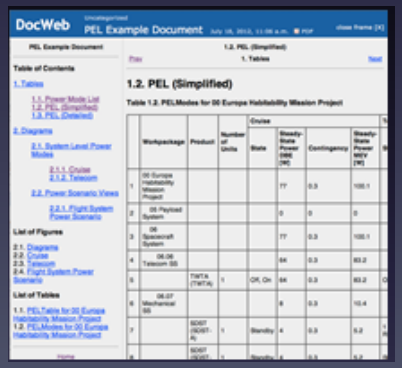
Generating Reports from Models





- Model, Viewpoints and View Models

Model transformation from SysML to Documents (HTML, PDF etc)



- Reports output using styles and formats specified in the method

Conclusions

- MBSE Success has a strong dependence on the capability to communicate with stakeholders and system implementers.
  - SysML provides the basic semantics to model and generate these artifacts
  - Use of web applications can provide an accessible mechanism for interacting and data collection from stakeholders
  - Model based document generation from View models puts the value of models into the work products systems engineers must deliver.
  - A scalable enterprise for modeling is feasible built around the concept of view point and view.

Backup